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## HEPATICS WITH HAND-LENS.

A. J. GROUT.

There has been a considerable demand for a simple book on the Hepatics. To meet this demand I am preparing a treatment of the Hepatics similar to that which I have given the mosses in "Mosses with a Hand-Lens." This will be included in the second edition of that book now in preparation (See adv. in this No. of the BRYOLOGIST). This key to the genera is printed here with the hope that it will be used and criticised by the readers of the BRYOLOGIST, and that by the assistance of these criticisms the final treatment may be made more helpful. With the Queen  $\frac{1}{4}$ -inch achromatic triplet I am able to make out the more minute structures mentioned in the keys. Many of them, especially leaf structure, can not be made out satisfactorily unless the objects be mounted in water on a slide in the same manner as for a compound microscope. The slide should then be held up to the strong light, the slide being held with the left hand and the lens with the right, the right thumb resting upon that of the left hand so that the focus will not be distributed by any unsteadiness of the hands.

From now until winter closes in I shall be glad to attempt to name Hepatics for our subscribers if the specimens be accompanied by a stamp, full data for the label, and the best name the collector can give. Fresh material only is desired. Almost none of the books give the time of maturing spores of the different species, and I hope that our readers will send me all the data of this sort that they have. Comparatively few illustrations are possible in this article, but the figures in the sixth edition of Gray's Manual will prove very helpful. In working up this key I have been surprised to find that sterile Hepatics are, as a rule, much easier to identify than sterile mosses. Many of the species maturing their spores in early spring have the spores and capsules pretty fully developed in the preceding autumn so that some of the sporophyte characters are nearly always accessible. Hepatics shrivel more than mosses in drying and are best studied while fresh, especially the thalloid forms.

A few of the rare genera are omitted and in the completed treatment some of the minute or difficult species will not be included.

The Germans call the true mosses *Laubmoose*, meaning leafy mosses, and the Hepatics, *Lebermoose*, or liver mosses. The name Liverwort was originally applied to *Marchantia* because of its fancied resemblance to the liver. Because of this resemblance it was supposed to be a specific for all liver troubles according to the old doctrine of signatures. From this came the Latin name *Hepaticae* and the German *Lebermoose*. "Thus does the language of ignorant superstition become the adopted language of science."

The chief distinctions between Mosses and Hepatics have been noted in the BRYOLOGIST for April, 1899, but a few additional notes here may prove helpful.

The Hepatics may be leafy stemmed and appear much like mosses, or they may consist of a broad, flat and rather thin stem (thallus) which is usually closely applied to the substratum. These thalloid Hepatics might

be mistaken for some of the foliaceous lichens but the Hepatics are always much greener and produce spores in a very different manner.

In the leafy-stemmed Hepatics, often called Scale Mosses, the leaves are without midrib and are nearly always in two ranks and flattened so as to lie in one plane, but in the great majority of cases there is a third rudimentary row on the inner side which are called underleaves, or amphigastria by those devoted to technical names. The pedicel which corresponds to the seta of the mosses does not, as a rule, grow much until the spores are nearly ripe, when it elongates very rapidly. The pedicels and capsules are of a much more delicate structure than in the mosses so that they disappear soon after the spores have escaped, but the peculiar and characteristic scales or bracts around the base of the pedicel often remain much longer and help greatly in identifying species. Immediately surrounding the base of the pedicel is a tubular, somewhat three-sided organ called the inner involucre or perianth, surrounding this the outer involucre, called simply involucre by many authors. This latter may be either tubular or composed of separate leaf-like divisions of varied shapes, called involucreal leaves or bracts, or perichatall leaves or bracts, or simply bracts. Either one, or even both, of these involucres may be lacking in some species.

So far as possible gametophyte characters have been used in the keys and descriptions and in the great majority of cases identification is easy from this part of the plant alone. Hepatics generally grow in moist situations on soil, roots of trees, and decaying wood.

### Key to Families.

Plants leafy, mosslike in appearance except for the two-ranked leaves entirely lacking midrib..... Scale Mosses (Jungermanniaceæ).

Plants consisting of a flattened green thallus, sometimes nearly circular but usually elongated and branching. (See illustrations of *Riccia*, *Marchantia*, *Anthoceros*, etc.) ..... A.

#### A.

1. Capsules, if present, immersed in the tissue of the plant. Plants floating on the surface of still water or floating on the mud along the banks..... *Riccia*.

Capsules raised well above the thallus. Plants often growing in mud but never floating..... 2.

2. Stomata (in our genera) present, easily discernable with a lens as small pores on the upper surface of the rather thick thallus; capsule borne on a special stalked receptacle as in *Marchantia*.

Liverworts (*Marchantiaceæ*).

Stomata not present, on the thinner thallus; capsules never borne on a special stalked receptacle..... 3.

3. Capsules very long and slender, splitting into two valves when ripe after the manner of a mustard pod, the slender hairlike columella remaining in the center..... Horned Liverworts (*Anthocerotaceæ*).

Capsules globular or ovoid, splitting into four valves; columella lacking.

Thalloid Scale Mosses (*Metzgeriaceæ*).

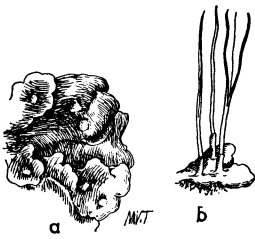


FIG. 1.

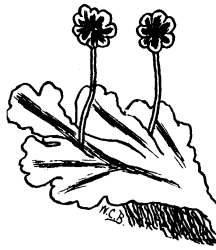


FIG. 2.

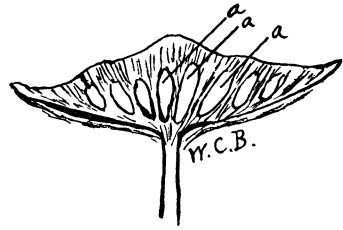


FIG. 3.



FIG. 4.

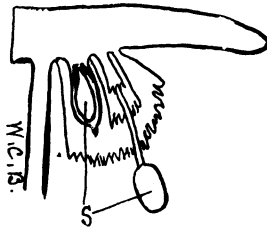


FIG. 5.



FIG. 6.

PLATE XII.

Fig. 1. a, Sterile and b, fertile thallus *Anthoceros punctatus*  $\times 2 \& 1$ .

Fig. 2-6. *Marchantia polymorpha*, from BRVOLOGIST, 4:34-35, 1901. Fig. 2. Male plant a little reduced, showing antheridial receptacles. Fig. 3. Longitudinal section of antheridial receptacle magnified. Fig. 4. Female plant reduced showing the stalked receptacles which characterize this family. These receptacles vary in the family from the shape shown in this figure to almost perfectly conical and entire. Fig. 5. Section of a part of a female receptacle magnified, showing two sporogonia. The seta of one has elongated, pushing the capsule out from the outer fringe (involucre) and the inner fringe (perianth) at the base of the seta is a little collar representing the base of the broken calyptra. Fig. 6. Sterile thallus with gemmæ.

**THE TRUE LIVERWORTS (MARCHANTIACEÆ).**

The plants of this family consist of thallus of medium to large size, one-half to six inches in length, usually branching dicotomously but sometimes with more than two branches at a fork. They are attached to the substratum by numerous root hairs and are thickened in the middle to form a midrib. This in some cases is not very apparent above but shows plainly underneath. The upper surface is covered with small pores (stomata) which are very apparent with a lens, except in *Reboulia*. The capsules are spherical or ovoid

and open irregularly by imperfect valves or by a portion of the top coming off after the manner of a lid. In this family the capsules and usually the antheridia are borne on special long-stalked receptacles well illustrated by the familiar *Marchantia*.

#### Key to the Genera.

1. Sterile stems bearing abundant gemmæ in shallow open receptacles....2  
Sterile stems without gemmæ .....3
- 2 Found only in and around greenhouses; gemmæ in crescent-shaped receptacles; never fruiting in our region.....*Lunularia*.  
Growing abundantly everywhere; gemmæ in cup-shaped receptacles; capsule-bearing receptacle with 7-11 conspicuous rays.....*Marchantia*.
3. Thallus large; 2-6 inches long and  $\frac{1}{2}$  inch or more wide, distinctly areolate as in *Marchantia*, but areolæ larger and hexagonal... *Conocephalus*.  
Thallus less than two inches in length and much narrower..... 4
4. Pores (stomata) scarcely distinguishable; antheridia in sessile receptacles which might be mistaken for gemmæ; thallus purple on the margins; midrib strong underneath but not conspicuous above.....*Reboulia*.  
Pores conspicuous, white; antheridia in peduncled disk-like receptacle; thallus with numerous dark purple scales underneath....*Preissia*.  
Pores conspicuous; antheridia immersed in the thallus; thallus purple underneath, at least along the margins .....5
5. Perianth conspicuous, split into 8-16 fringe-like lobes; peduncle not chaffy.....*Asterella*.  
Perianth lacking; peduncle chaffy at top and bottom.....*Grimaldia*.  
(The *Reboulia* of this key is the *Asterella* of Gray's Manual and the *Asterella* is the *Fimbriaria* of that work.)

#### THE THALLOID SCALE MOSSES (METZGERIACEÆ).

The spore bearing portion of plants of this family is like that of the Scale Mosses, but the green part of the plant is a thallus instead of a leafy stem in nearly all cases. There are, however, some intermediate forms in the family in which the thallus is divided into leaflike lobes. The thallus is much less highly differentiated than in the Liverworts and *Riccias*; there are no areolæ or pores (stomata), and the thallus is much thinner than in the Liverworts, in some species consisting of only a single layer of cells except at the midrib. The capsules are borne singly on setæ arising directly from the thallus. They are spherical to elongated-ovoid and remain enclosed in the calyptra until mature when the setæ rapidly elongate and break open the calyptra which is left at the base of the seta. The capsules open by four valves as in many of the Scale Mosses. A careful search of wet bare earth in shaded or springy places will nearly always yield one or more species of this family.

#### Key to the Genera.

1. Thallus with a distinct midrib .....2.  
Thallus without a distinct midrib.....4.
2. Thallus  $\frac{1}{25}$  to  $\frac{1}{12}$  inch wide, dichotomously branched, cilliate along the margins.....*Metzgeria*.

Thallus  $\frac{1}{3}$  to  $\frac{1}{2}$  inch wide, not ciliate at margins, entire or lobed.....3.  
 3. Thallus simple or only once forked, 1 to 4 inches long, prostrate; margins sinuate to entire; capsule ovoid-cylindric.....Pallavicinia.

Thallus dichotomously branched,  $\frac{3}{4}$  to 1  $\frac{1}{2}$  inches long, often densely clustered and ascending, margins lobed; capsules spherical without perianth, appearing buried in the midrib for some time before the ripening of spores (Fig. 7).....Blasia.

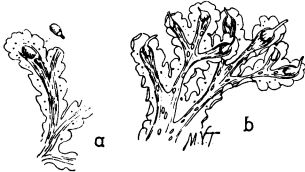


Fig. 7.

4. Thallus pinnately or palmately branched,  $\frac{1}{24}$  to  $\frac{1}{12}$  in wide (except *R. pinguis*).....Riccardia.  
 Thallus subsimple or dichotomously branched,  $\frac{1}{8}$  to  $\frac{1}{3}$  inch in width (Fig. 8).....Pellia.



Fig. 8.

Fig. 7. *Blasia pusilla* L. a. Fertile plant in August showing capsule in position. At the side is shown the capsule removed from the thallus. b. Sterile plant with flask-shaped bodies which produce gemmæ.

Fig. 8. *Pellia epiphylla* Raddi. Thallus  $\times 1$ , showing involucre and position of capsule as it appears in August.

#### THE SCALE MOSSES (JUNGERMANNIACEÆ).

The reproductive part of the Scale Mosses, including the ripened capsule and its connected parts, perianth, involucre, etc., is essentially as in the Thalloid Scale Mosses, but the vegetative part strongly resembles the true mosses in general appearance. The leaves, however, are apparently flattened out into two rows, one on either side of the stem. They are entirely without midrib and are frequently two-cleft or lobed. One of the lobes is often smaller and folded under the other making the leaves "complicate-bilobed," in the language of the books as shown in the illustrations of *Radula* and *Porella*. This can best be made out by holding a single stem up to the light and examining with a lens, when the under lobe will show plainly as a deep shadow. In *Scapania*, the under lobe is the larger and the plants look as if there were four rows of leaves. The lower lobe is called the lobule and the upper simply the lobe. Very many species have a third rows of leaves on the under side of the stem called technically "amphigastria" or underleaves, these vary in size from one-third the size of the ordinary leaves to so minute that high powers of the compound microscope are needed to see them clearly. The upper margin of the leaves may overlap the lower margins of the leaves next above as in *Porella*, or the upper margin of a leaf may lie under the lower margin of the leaf next above as in *Plagiochila*. In the former case the leaves are said to be incubous, in the latter succubous. As this distinction is in most cases easy to observe, it is given a prominent part in the key. Occasionally the leaves are so far apart that it is hard to determine the leaf arrangement, but a careful search

will usually discover some plants in which this character can be seen. In plants with incubous leaves the bud is turned downward; when the leaves are succubous the terminal bud is turned up. So far as possible the key has been based upon the leafy or vegetative portions of the plants, but in some few cases the characters connected with the reproductive organs and capsules are necessary to accurately determine a plant. In most cases the characters used can be determined without mounting, if, however, they can not be readily made out the parts should be mounted as for the compound microscope. If one has access to a compound microscope it will often prove a very great help, although not necessary to make out the characters mentioned. Mnium and Fissidens are sure to be mistaken for Hepatics by the beginner unless the midrib or the leaves is noted.

### Key to the Genera and Species.

1. Leaves entirely or in large part composed of hair-like divisions (easily observed if held up towards a strong light) ..... 2.  
Leaves not as above ..... 3.
2. Plants grayish green, growing over the ground amid mosses in cool bogs, at least twice pinnate and somewhat resembling the Fern Mosses; leaves divided to base into hair-like lobes ..... Trichocolea.  
Plants dark green, much smaller, growing chiefly on rotten wood, but also found on humus-covered stones and soil; leaves with a considerable solid portion ..... Ptilidium.  
Plants exceedingly minute, looking like a small green alga or moss protonema. Scarcely recognizable except when fruited; common on decayed wood, moist soil, etc. .... Blepharostoma.
3. Leaves incubous ..... A.  
(Scapania and Chiloscypus forms may be sought here.)  
Leaves succubous ..... B.

#### A.

1. Leaves complicate-bilobed, upper lobes entire or nearly so (except Jubula). See figures and description of Porella... 2.  
Leaves sometimes lobed or cleft but not complicate-bilobed ..... 5.
2. Plants blackish or brownish green, minute, leafy stems  $\frac{1}{25}$  inch or less wide; lobule like an inflated sac (Plate XIV) ..... Frullania.  
Plants often dark olive-green but not often blackish;  $\frac{1}{16}$  inch in width, lobule not sac-like ..... 3.
3. Under leaves lacking; perianth strongly flattened crosswise (Plate XIII) ..... Radula.  
Underleaves conspicuous ..... 4.
4. Lobule with its longer edge attached to lower margin of lobe (See cuts, Plate XIII) ..... Lejeunea.  
Lobule with its shorter margin attached to the lower edge of lobe (Plate XIV) ..... Porella.
5. Leaves mostly entire ..... Kantia.  
Leaves strongly toothed, notched, or cleft at apex ..... 6.
6. Leafy stems less than  $\frac{1}{25}$  inch in width ..... Lepidozia.

Leafy stems  $\frac{1}{16}$  to  $\frac{1}{4}$  inch in width, with downward growing stolons  
(Plate XIII)..... *Bazzania*.

### B.

1. Leaves complicate-bilobed, lobes nearly equal or the lower larger giving the appearance of four rows of leaves of which the two upper are incubous and the two lower succubous..... *Scapania*.  
Leaves not complicate-bilobed, in some cases toothed or divided..... 2.
2. Leaves undulate on the margin; plants densely clustered; root hairs bright claret colored..... *Nardia hyalina*.  
Leaves entire or slightly emarginate; root hairs colorless..... 3.  
Some or usually all of the leaves strongly toothed or lobed; root hairs colorless..... 7.
3. Leafy stems at least  $\frac{1}{8}$  inch wide, leaves plainly overlapping, on ground and over mosses..... 5.  
Plants about  $\frac{1}{8}$  inch wide; many leaves not overlapping..... 4.  
Leafy stems  $\frac{1}{16}$  inch wide or less..... 6.
4. Aquatic, floating, underleaves absent.  
*Chiloscyphus polyanthus* var. *rivularis*.  
On old logs and moist ground, underleaves present..... *Chiloscyphus*.
5. Plants creeping; leaves oblong to oblong-ovate, decurrent.... *Lioclæna*.  
Plants ascending; leaves round obovate, not decurrent..... *Plagiochila*.
6. Leaves with a border of larger cells which appear as a whitish margin under the lens..... *Odontoschisma* and *Nardia crenulata*.  
Leaves without border of larger cells..... *Jungermannia Schraderi*.
7. Upper leaves with a strongly many toothed margin..... *Plagiochila*.  
Leaves 3-5 cleft ..... *Jungermannia barbata*.  
Leaves two toothed or cleft ..... 8.
8. Plants minute, leafy stems less than  $\frac{1}{25}$  inch wide; underleaves absent or so small as to be invisible with a lens; leaves round-ovate to obovate, cleft for at least  $\frac{1}{3}$  their length..... *Cephalozia*.  
(Some small species of *Jungermannia* may be sought here but their leaves are less deeply cleft and the plants are a much darker green).  
Leafy stems at least  $\frac{1}{16}$  inch wide; leaves two toothed but scarcely cleft .9
9. Underleaves  $\frac{1}{3}$  the size of the other leaves..... *Lophocolea minor*.  
Underleaves absent or minute ..... 10.
10. Leaves subvertical, varying from bidentate to retuse, or even entire near apex..... *Lophocolea heterophylla*.  
Leaves with the edge attached nearly lengthwise of the stem, extending out at almost right angles from it and lying flat in a horizontal plane. *Geocalyx*.  
Leaves subvertical and all alike inserted more nearly crosswise of the stem..... 11.
11. On sterile ground in open woods..... *Jungermannia excisa*.  
On rotten wood..... 12.
12. Leaves round-ovate with an obtuse sinus between the teeth. *Harpanthus*.  
Leaves subrectangular with an acute sinus; plants dark to brownish green..... *Jungermannia Michauxii*.



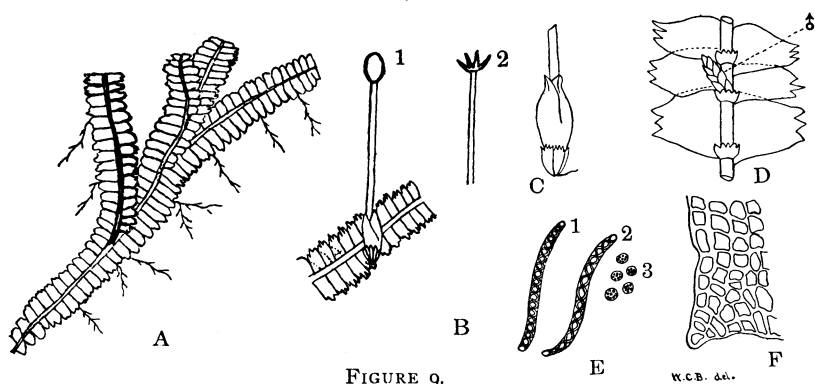


FIGURE 9.

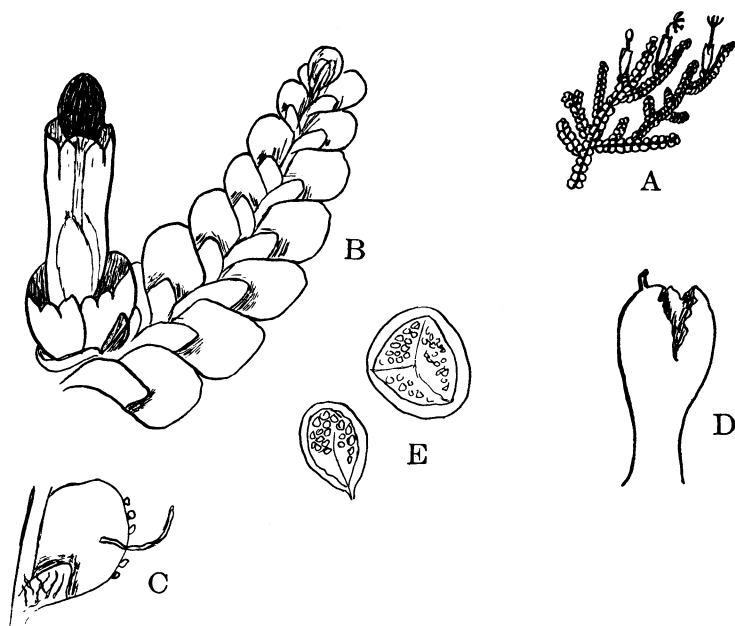


FIGURE 10.



FIGURE 11.

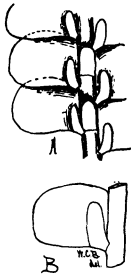


FIG. 12.

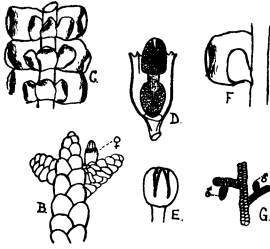


FIG. 13.

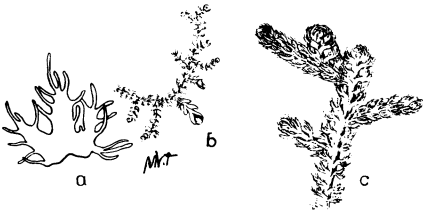
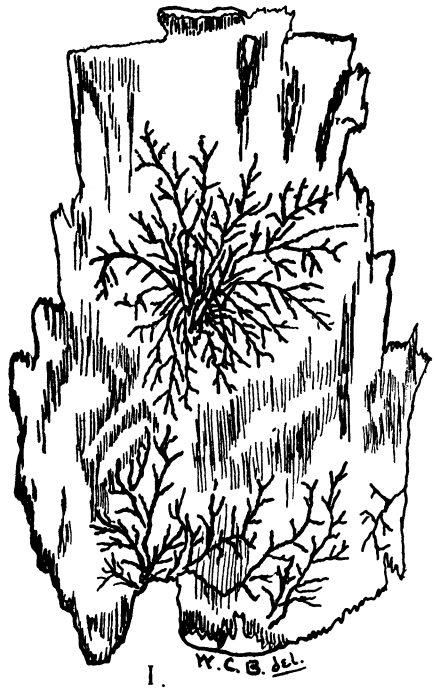


FIG. 15.



I.

II.

III.



IV.



V.

FIG. 14.

### EXPLANATION OF PLATES.

Plate XIII. Fig. 9. *Bazzania trilobata* (L.) S. F. Gray. From BRYOLOGIST, 4: 68, 1901. A. Plant slightly magnified showing flagella springing from the underside. B. (1.) Portion of female plant with capsule. (2.) Capsule open. C. Involucre, perianth and base of seta enlarged. The involucre consists of the small leaves at the bottom of the figure. D. Male plant seen from below, showing antheridial branch, minute underleaves and incubous arrangement of leaves. E. & F. Illustrate spiral elators, spores and cell structure of leaf which cannot be seen clearly with a hand-lens.

Fig. 10. *Radula complanata* Dumort. A. Plant natural size. B. Branch with fruit showing clearly the seta and capsule, with the calyptra at base of seta showing through the transparent tubular perianth, and at base of the perianth, the involucre. This misrepresents the leaves, making them appear succubous. C. Leaf showing lobule with root hairs and larger lobe with gemmæ along the edge. This illustrates the simplest forms of "complicate-bilobed" leaf. There are no underleaves. D. Calyptra. E. Spores, highly magnified.

Fig. 11. Various species of *Lejeunea*, from BRYOLOGIST, 6: 27, 1903. Showing underleaves in all but the right hand figure. Note that the lobule is attached to the lobe by its longer edge.

Plate XIV. Fig. 12. *Porella pinnata* L. From the BRYOLOGIST, 5: 34, 1902. A. Underside of stem showing narrow underleaves and narrow lobules attached by their shorter edge to lobe. B. Single leaf showing lobe and lobule.

Fig. 13. *Porella platyphylla* (L.) Lindb. From BRYOLOGIST, 5: 35, 1902. B. Upper side of stem showing perianth and emerging capsule. Also showing clearly incubous arrangement of leaves. C. Underside of stem, the leaves shown too far apart. D. Longitudinal section of perianth. E. Capsule. F. Leaf. G. Part of plant showing male branches.

Fig. 14. *Frullania*. From BRYOLOGIST, 5: 4, 1902. I. Plant of *Frullania Eboracensis* Gottsche., on the bark of birch. II. Underside of same showing underleaves and the queer saclike inflated lobules which remind one of the bladders of *Utricularia*. III. and IV. Under and upper side of *F. Asagrayana* Mont. V. Involucre and perianth of *F. Eboracensis*.

Fig. 15. *Ptilidium ciliare* (L.) Nees. a. Leaf  $\times 37$ . b. Plant with perianth and young capsule  $\times 2$ . c. Portion of plant  $\times 5$ .